CE257 Data Communication and Networking

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CE257 Data Communication and Networking

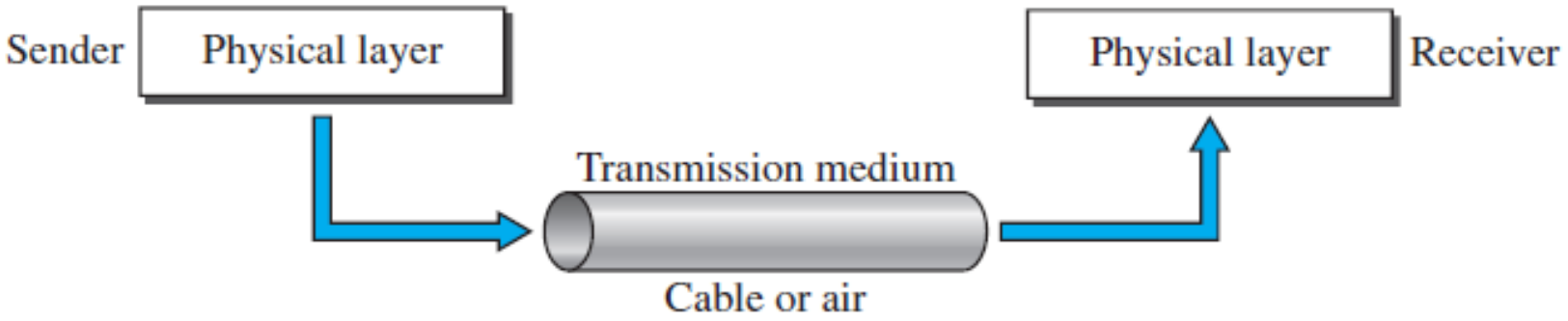
Week 5 – Session 2

STUDENTS WILL LEARN

- Analog Transmission
  - Transmission Media
    - Guided Media

TRANSMISSION MEDIA

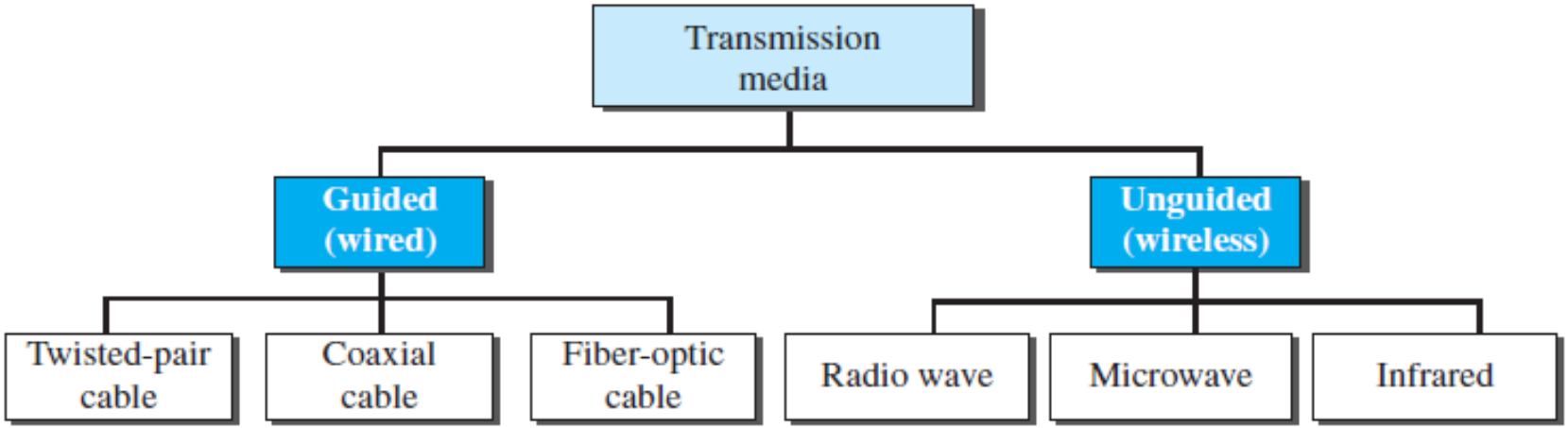
- Transmission media are actually located below the physical layer and are directly controlled by the physical layer.



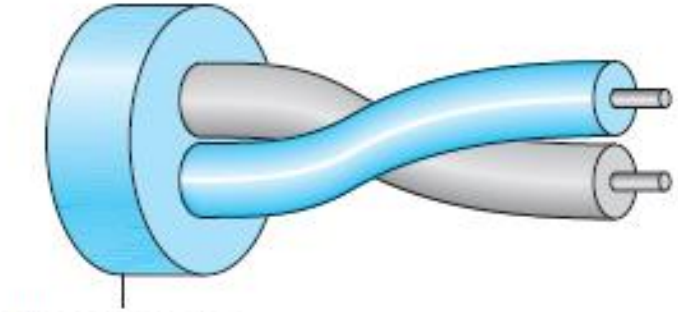
TRANSMISSION MEDIUM

- A **transmission medium** can be broadly defined as anything that can carry information from a source to a destination
- Wireless communication started in 1895 when Hertz was able to send high frequency signals. Later, Marconi devised a method to send telegraph-type messages over the Atlantic Ocean.

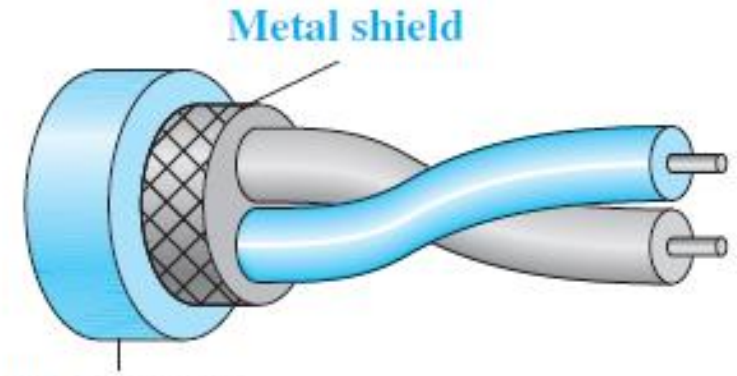
CLASSES OF TRANSMISSION MEDIA



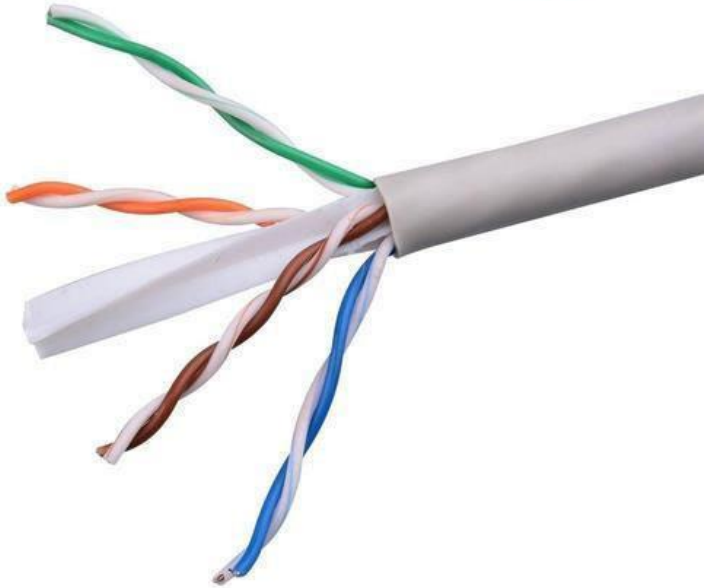
TWISTED PAIR CABLE



a. UTP



b. STP

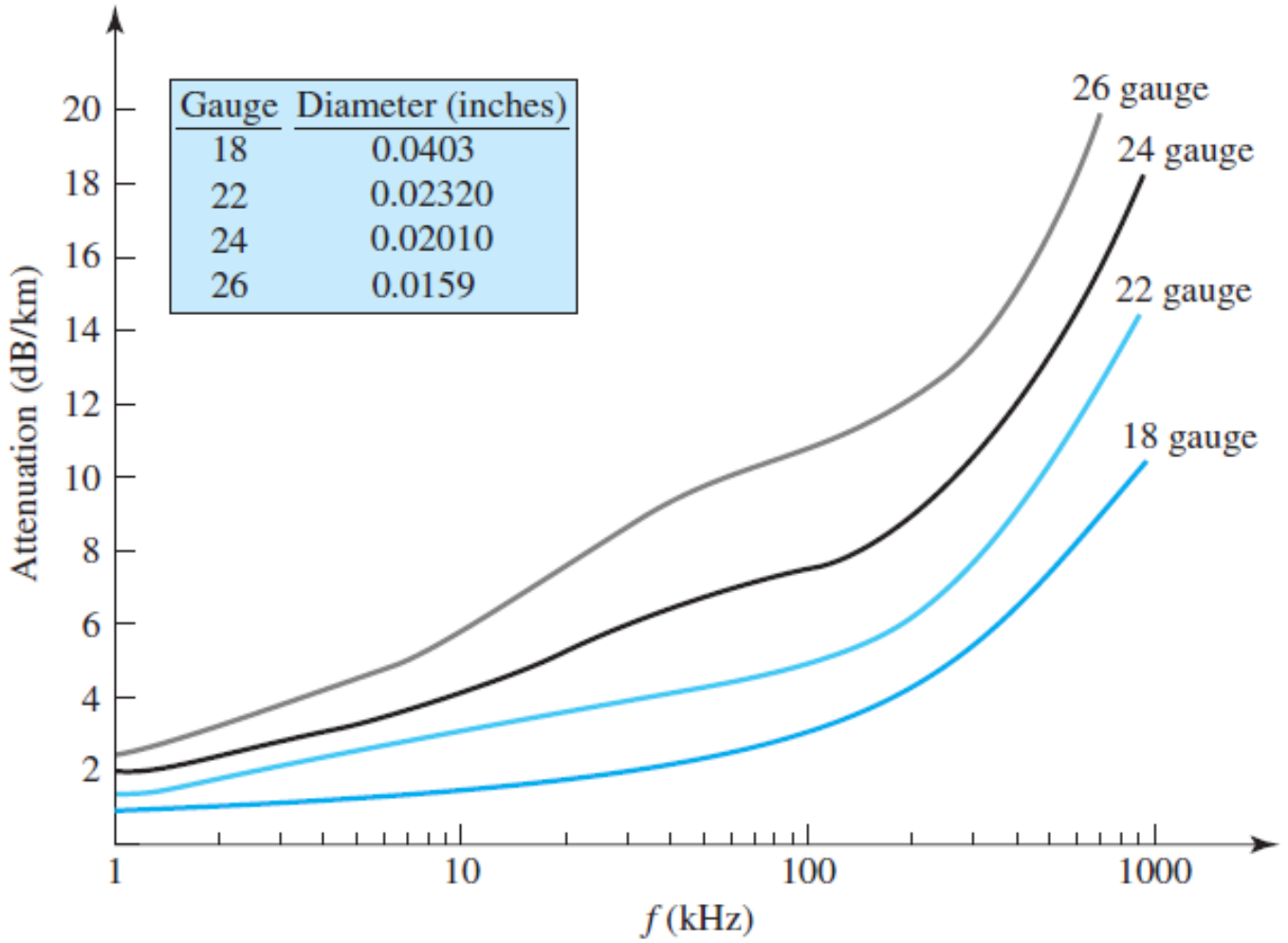


CATEGORY OF CABLES

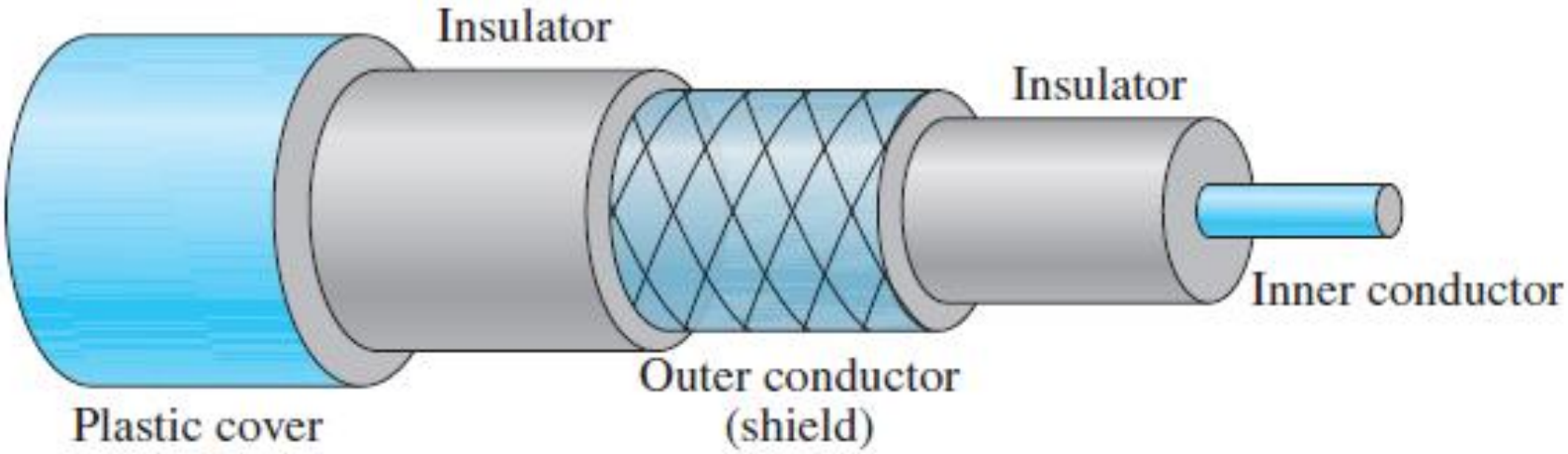
Category	*Specification*	*Data Rate (Mbps)*	*Use*
1	Unshielded twisted-pair used in telephone	< 0.1	Telephone
2	Unshielded twisted-pair originally used in T lines	2	T-1 lines
3	Improved CAT 2 used in LANs	10	LANs
4	Improved CAT 3 used in Token Ring networks	20	LANs
5	Cable wire is normally 24 AWG with a jacket and outside sheath	100	LANs

Category	*Specification*	*Data Rate (Mbps)*	*Use*
5E	An extension to category 5 that includes extra features to minimize the crosstalk and electromagnetic interference	125	LANs
6	A new category with matched components coming from the same manufacturer. The cable must be tested at a 200-Mbps data rate.	200	LANs
7	Sometimes called *SSTP (shielded screen twisted-pair)*. Each pair is individually wrapped in a helical metallic foil followed by a metallic foil shield in addition to the outside sheath. The shield decreases the effect of crosstalk and increases the data rate.	600	LANs

PERFORMANCE (UTP CABLES)



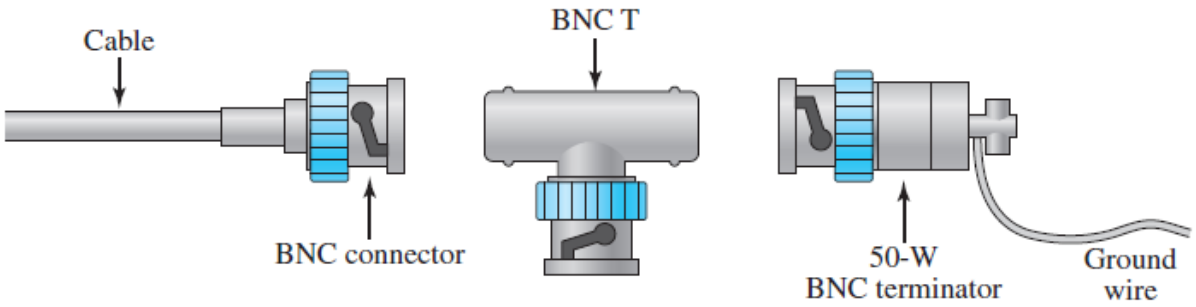
COAXIAL CABLE



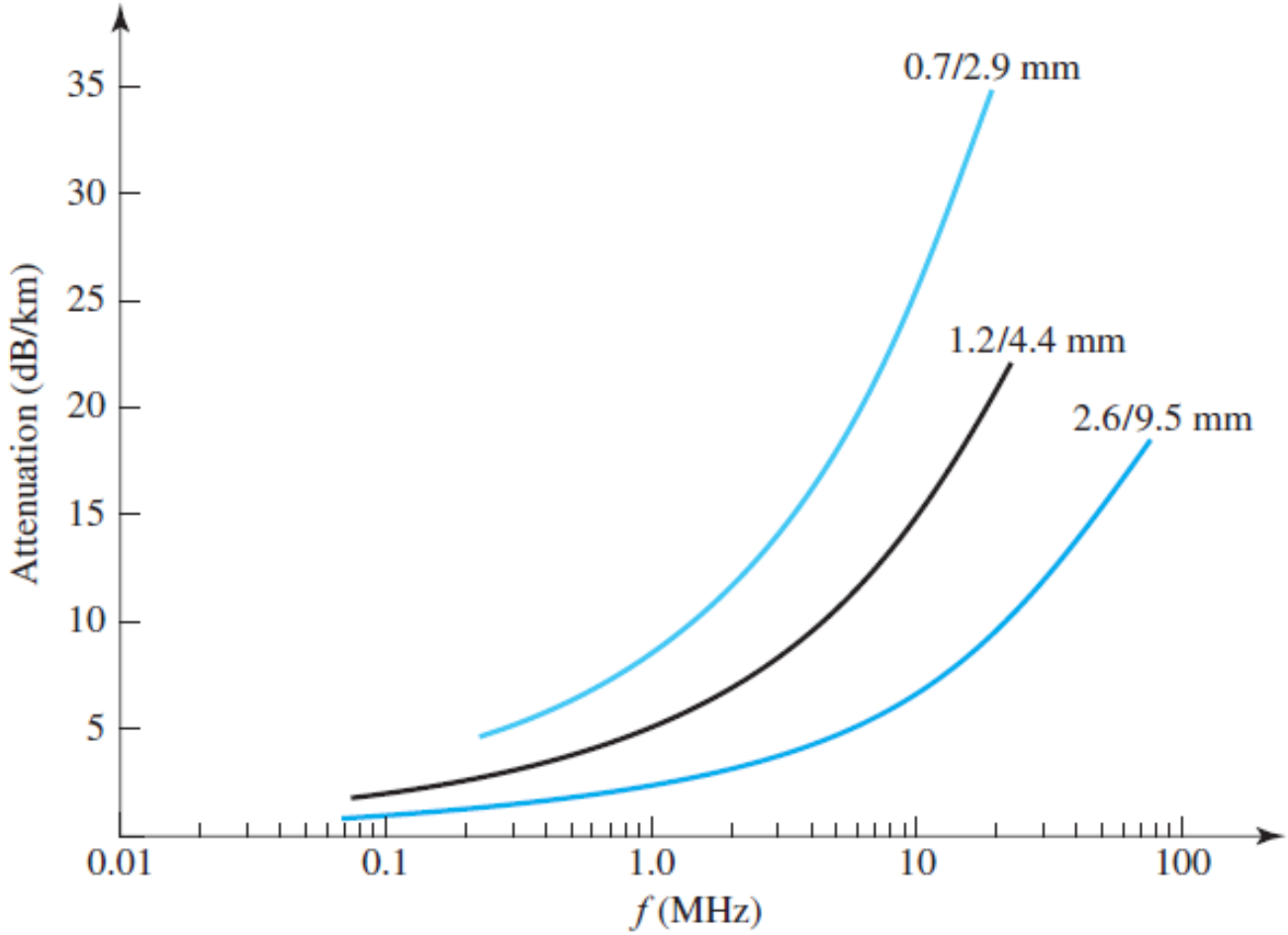
COAXIAL CABLE STANDARDS

Category	*Impedance*	*Use*
RG-59	75 Ω	Cable TV
RG-58	50 Ω	Thin Ethernet
RG-11	50 Ω	Thick Ethernet

COAXIAL CABLE CONNECTORS



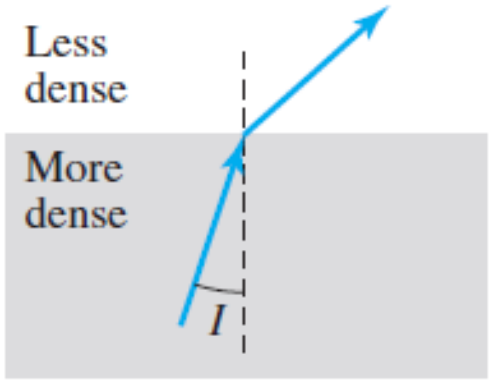
COAXIAL CABLE PERFORMANCE



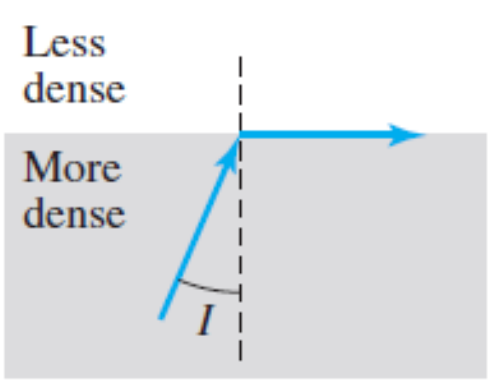
FIBER-OPTIC CABLE

- A fiber-optic cable is made of glass or plastic and transmits signals in the form of light.
- Light travels in a straight line as long as it is moving through a single uniform substance.
- If a ray of light traveling through one substance suddenly enters another substance (of a different density), the ray changes direction.

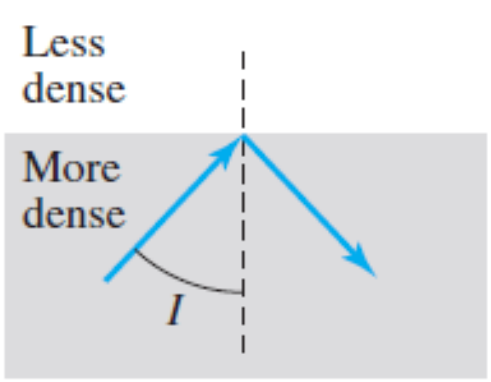
PROPERTY OF LIGHT RAY



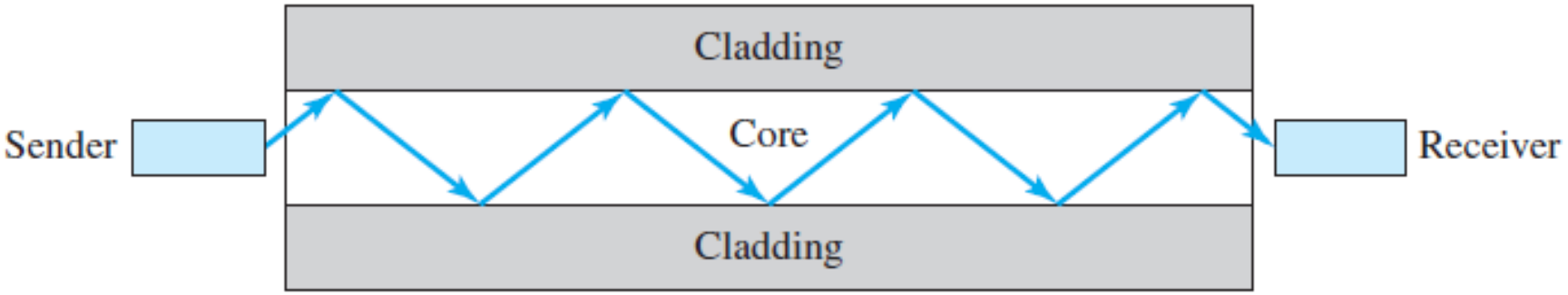
$I <$ critical angle, refraction



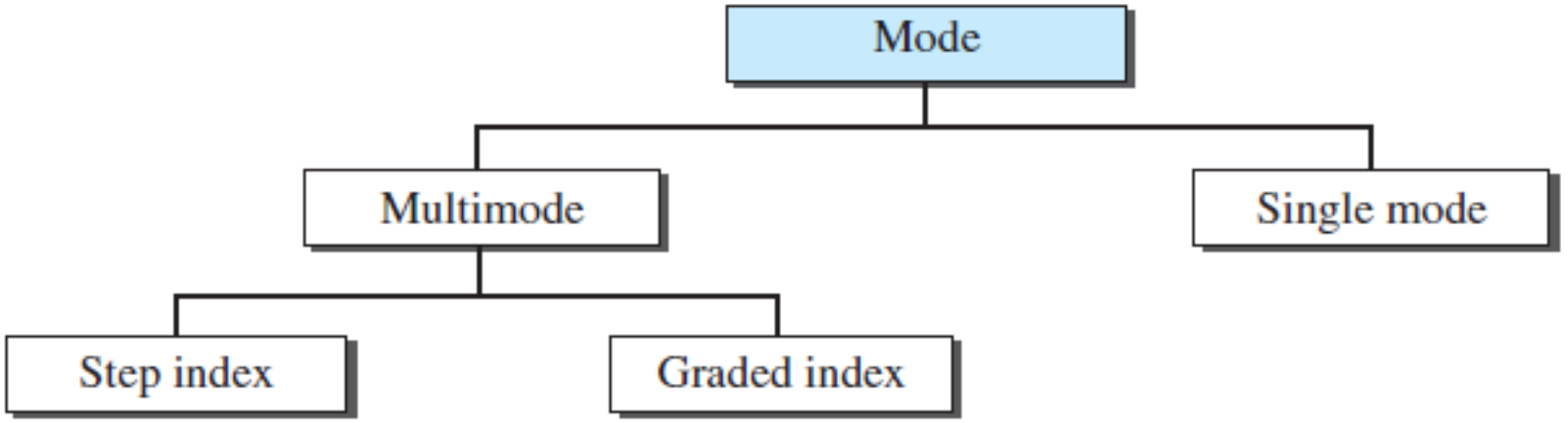
$I =$ critical angle, refraction



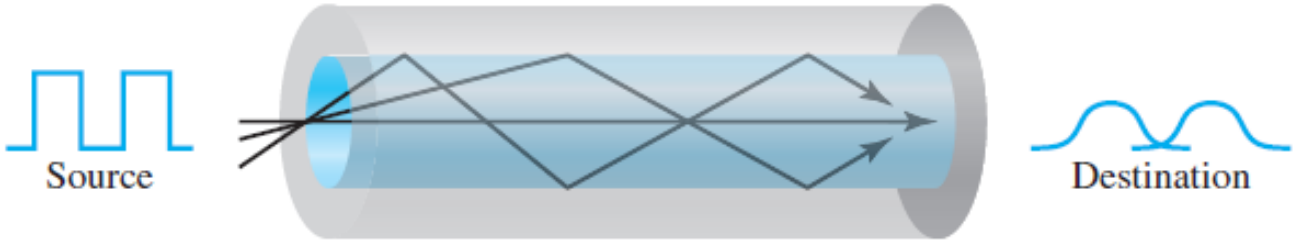
$I >$ critical angle, reflection



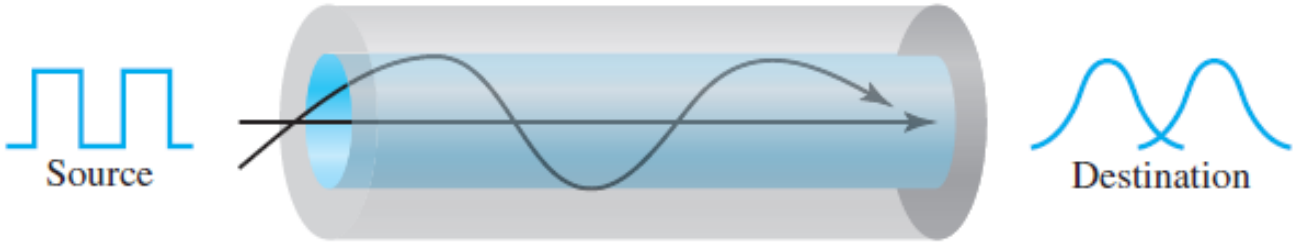
PROPAGATION MODES



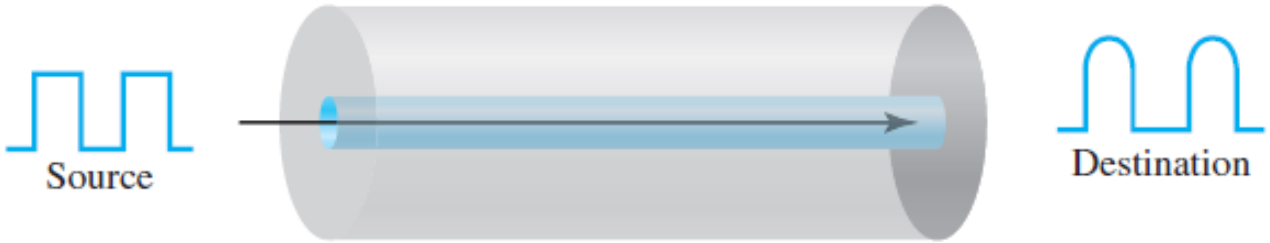
MODES



a. Multimode, step index



b. Multimode, graded index

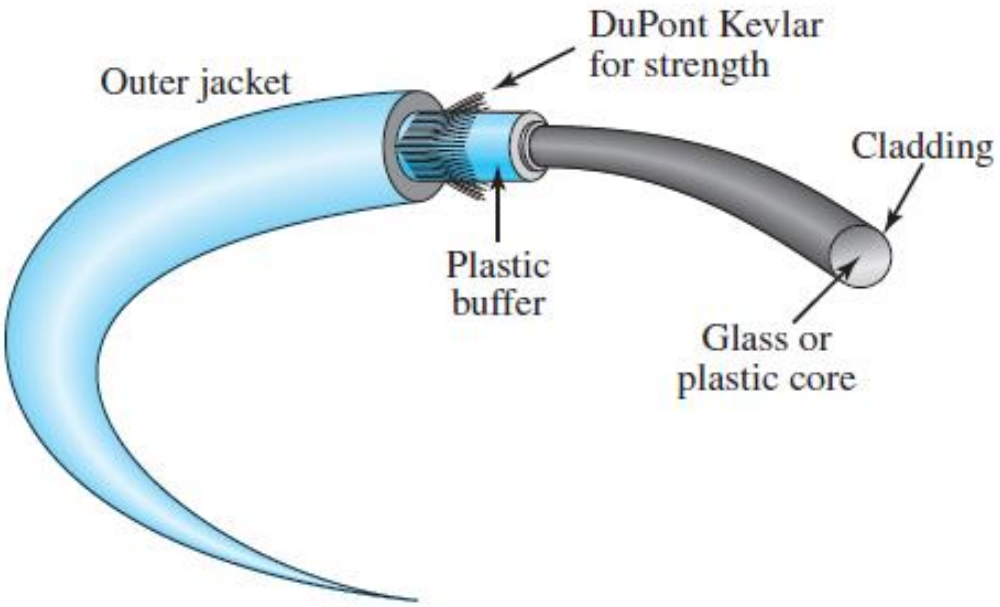


c. Single mode

FIBER SIZES

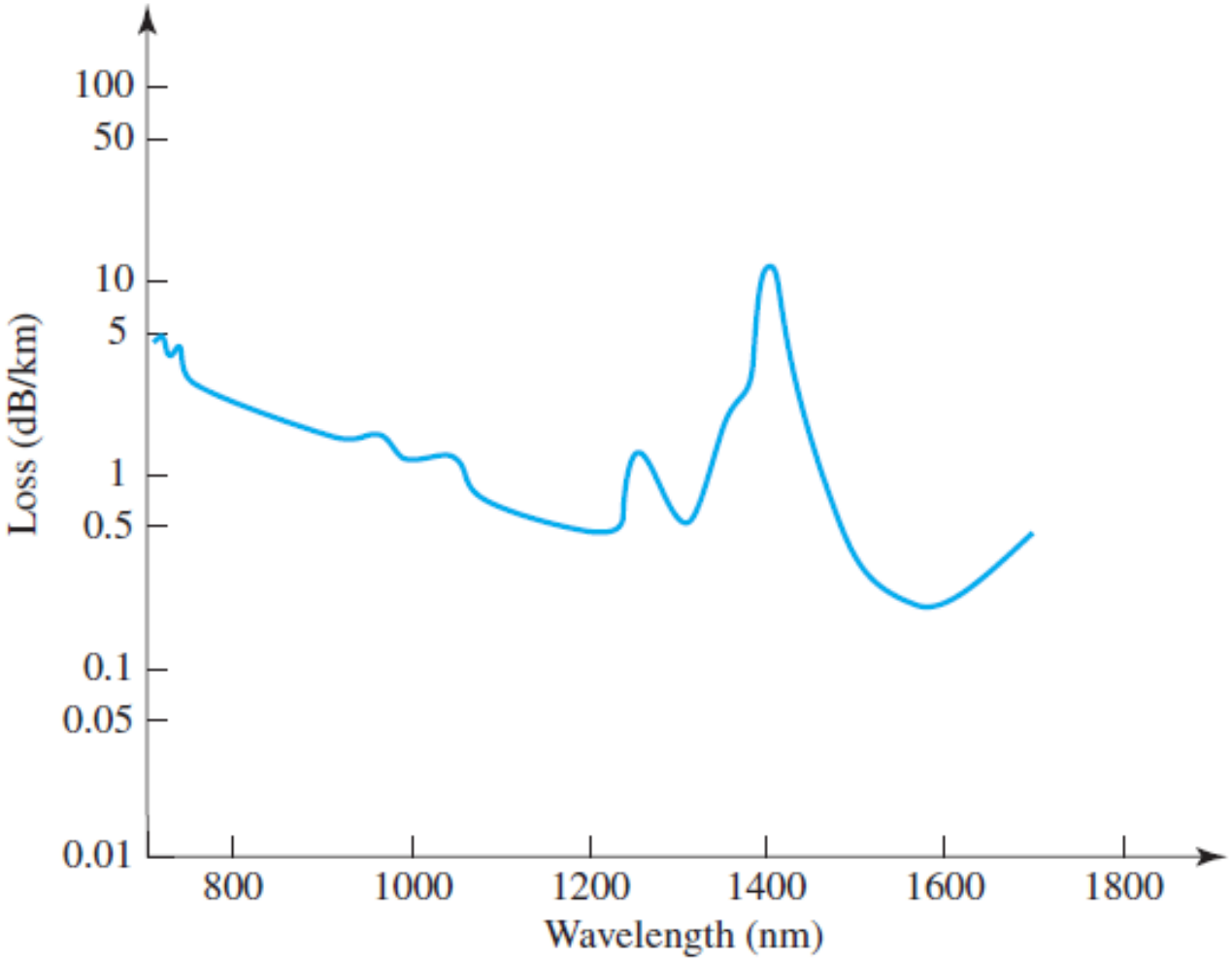
Type	*Core (μm)*	*Cladding (μm)*	*Mode*
50/125	50.0	125	Multimode, graded index
62.5/125	62.5	125	Multimode, graded index
100/125	100.0	125	Multimode, graded index
7/125	7.0	125	Single mode

CABLE COMPOSITION



FIBER-OPTIC CABLE CONNECTORS

OPTICAL FIBER PERFORMANCE



ADVANTAGES AND DISADVANTAGES OF OPTICAL FIBER

- *Advantages*
  - Higher bandwidth
  - Less signal attenuation
  - Immunity to electromagnetic interference
  - Resistance to corrosive materials
  - Light weight
  - Greater immunity to tapping
- *Disadvantages*
  - Installation and maintenance
  - Unidirectional light propagation
  - Cost.

CE257 Data Communication and Networking

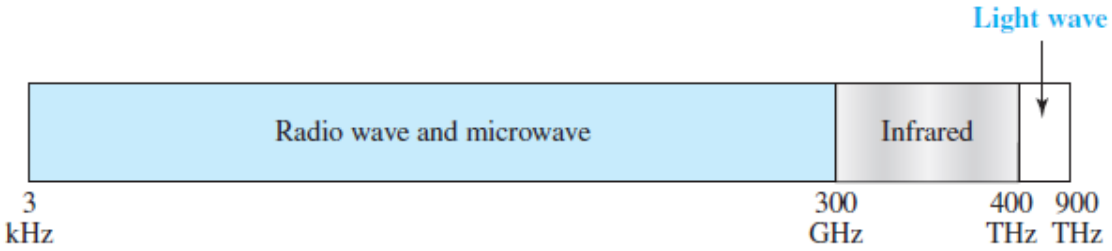
Week 5 – Session 3

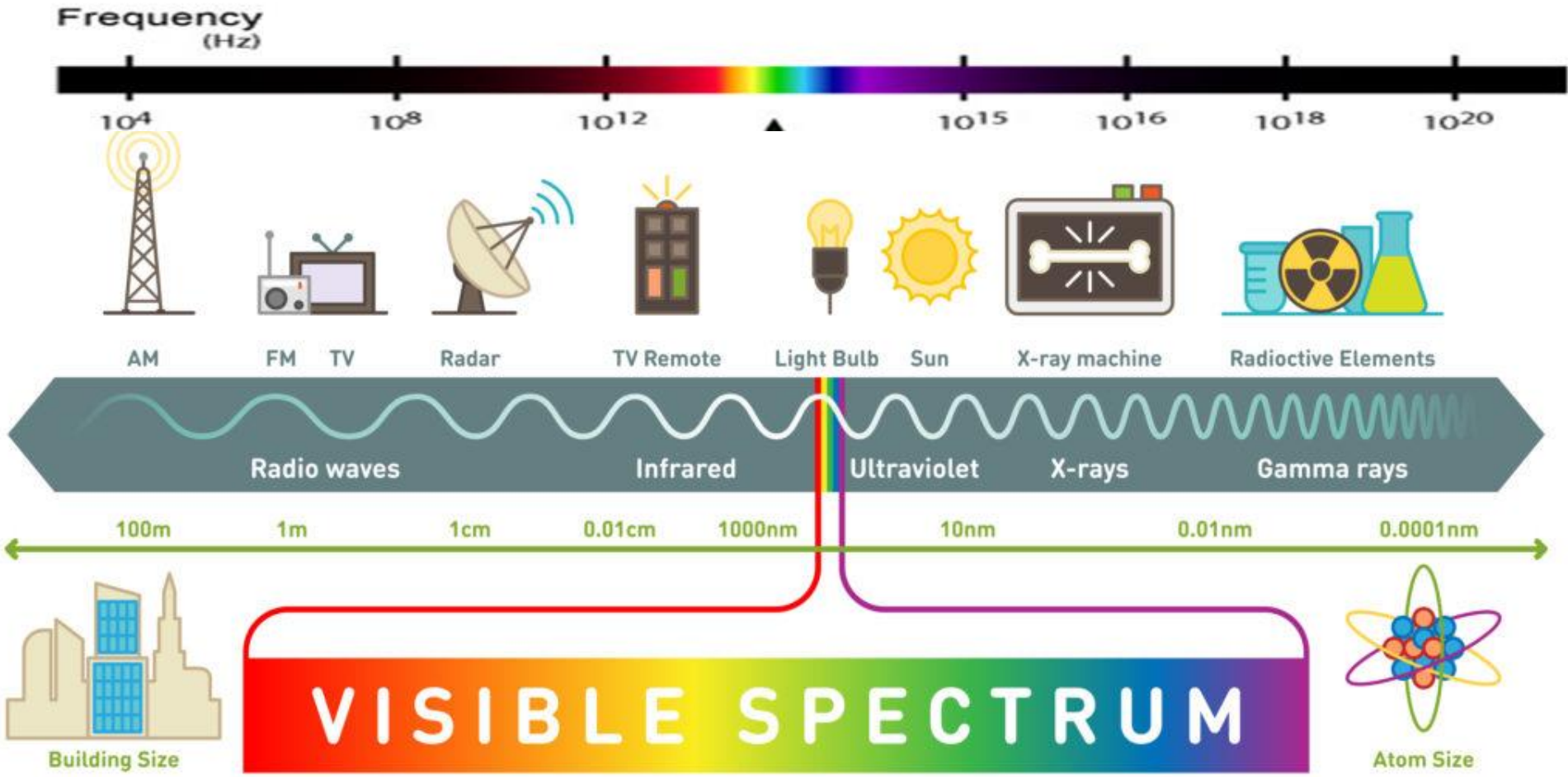
STUDENTS WILL LEARN

- Analog Transmission
  - Transmission Media
    - Guided Media
    - **UnGuided Media**

UNGUIDED MEDIA

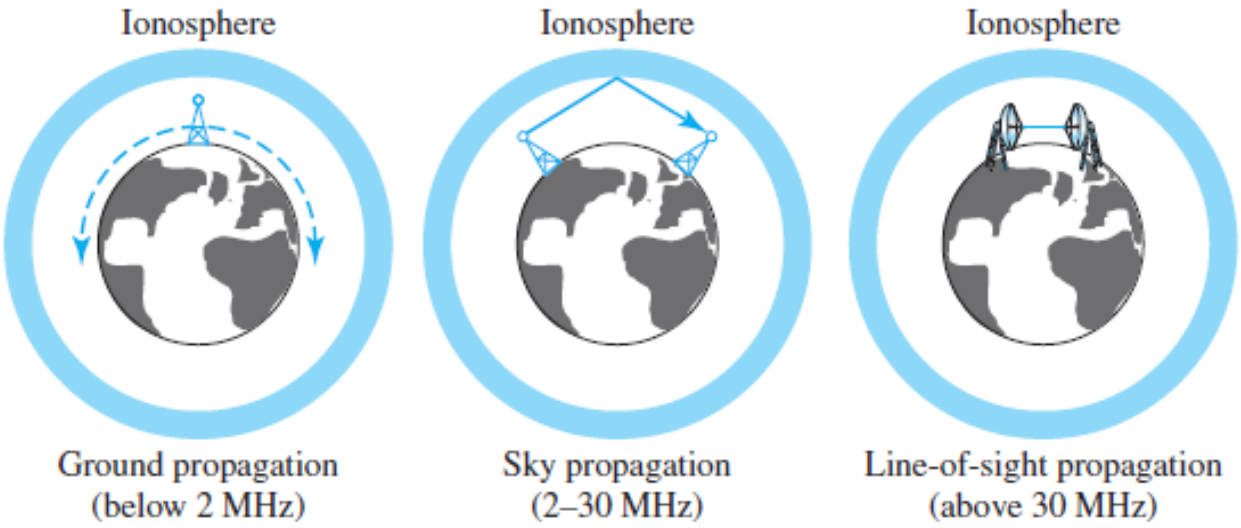
- **Unguided medium** transport electromagnetic waves without using a physical conductor.
  - normally broadcast through free space →
  - and thus are available to anyone who→
  - has a device capable of receiving them.




Frequency
(Hz)
10^4
10^8
10^12
10^15
10^16
10^18
10^20
AM
FM
TV
Radar
TV Remote
Light Bulb
Sun
X-ray machine
Radioctive Elements
Radio waves
Infrared
Ultraviolet
X-rays
Gamma rays
100m
1m
1cm
0.01cm
1000nm
10nm
0.01nm
0.0001nm
Building Size
VISIBLE SPECTRUM
Atom Size

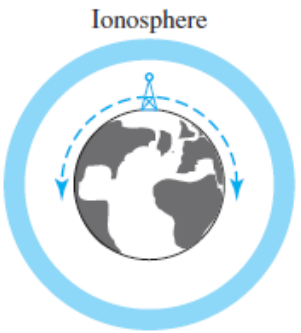
UNGUIDED MEDIA

- Unguided signals can travel from the source to the destination in several ways:
  - ground propagation,
  - sky propagation,
  - and line-of-sight propagation,



GROUND PROPAGATION

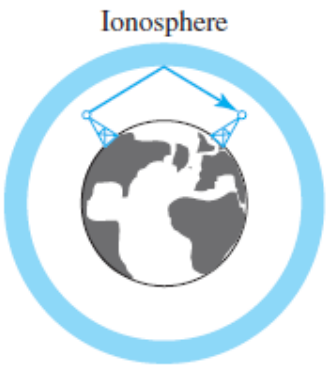
- In **ground propagation,** radio waves travel through the lowest portion of the atmosphere
- These **low-frequency** signals emanate in **all directions** from the transmitting antenna and follow the curvature of the planet.
- Distance depends on the amount of power in the signal: **The greater the power, the greater the distance.**



Ground propagation
(below 2 MHz)

SKY PROPAGATION

- In **sky propagation,** higher-frequency radio waves radiate upward into the ionosphere (the layer of atmosphere where particles exist as ions) where they are reflected back to earth.
- This type of transmission allows for greater distances with lower output power.



Sky propagation
(2–30 MHz)

LINE-OF-SIGHT PROPAGATION

Line-of-sight propagation
(above 30 MHz)

- In **line-of-sight propagation,** very high-frequency signals are transmitted in straight lines directly from antenna to antenna.
- Antennas must **be directional, facing each other,** and either **tall enough or close enough together** not to be affected by the curvature of the earth.
- Line-of-sight propagation is tricky because radio transmissions cannot be completely focused

BANDS

- The section of the electromagnetic spectrum defined as radio waves and microwaves is divided into eight ranges, called *bands*

Band	*Range*	*Propagation*	*Application*
very low frequency (VLF)	3–30 kHz	Ground	Long-range radio navigation
low frequency (LF)	30–300 kHz	Ground	Radio beacons and navigational locators

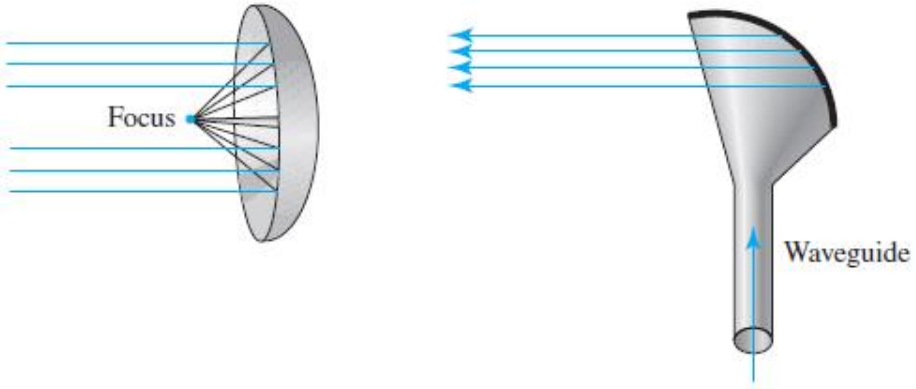
Band	*Range*	*Propagation*	*Application*
middle frequency (MF)	300 kHz–3 MHz	Sky	AM radio
high frequency (HF)	3–30 MHz	Sky	Citizens band (CB), ship/aircraft
very high frequency (VHF)	30–300 MHz	Sky and line-of-sight	VHF TV, FM radio
ultrahigh frequency (UHF)	300 MHz–3 GHz	Line-of-sight	UHF TV, cellular phones, paging, satellite
superhigh frequency (SF)	3–30 GHz	Line-of-sight	Satellite
extremely high frequency (EHF)	30–300 GHz	Line-of-sight	Radar, satellite

OMNIDIRECTIONAL

- The omnidirectional characteristics of radio waves make them useful for multicasting, in which there is one sender but many receivers. AM and FM radio, television, maritime radio, cordless phones, and paging are examples of multicasting

MICROWAVES

- Electromagnetic waves having frequencies between 1Ghz and 300 GHz are called microwaves.
- Microwaves are unidirectional.



a. Parabolic dish antenna

b. Horn antenna

APPLICATIONS

- Microwaves, due to their unidirectional properties, are very useful when unicast (one-to-one) communication is needed between the sender and the receiver.
- They are used in
  - cellular phones,
  - satellite networks,
  - and wireless LANs

INFRARED

- **Infrared waves,** with frequencies from 300 GHz to 400 THz (wavelengths from 1 mm to 770 nm), can be used for short-range communication.

- Thank you